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The Role of Atmospheric Measurements in Wind Power Statistical Models

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The simplest wind power generation curves model power only as a function of the wind speed at turbine hub-height. While the latter is an essential predictor of power output, it is widely accepted that wind speed information in other parts of the vertical profile, as well as additional atmospheric variables including atmospheric stability, wind veer, and hub-height turbulence are also important factors. The goal of this work is to determine the gain in predictive ability afforded by adding additional atmospheric measurements to the power prediction model. In particular, we are interested in quantifying any gain in predictive ability afforded by measurements taken from a laser detection and ranging (lidar) instrument, as lidar provides high spatial and temporal resolution measurements of wind speed and direction at 10 or more levels throughout the rotor-disk and at heights well above. Co-located lidar and meteorological tower data as well as SCADA power data from a wind farm in Northern Oklahoma will be used to train a set of statistical models. In practice, most wind farms continue to rely on atmospheric measurements taken from less expensive, *in situ* instruments mounted on meteorological towers to assess turbine power response to a changing atmospheric environment. Here, we compare a large suite of atmospheric variables derived from tower measurements to those taken from lidar to determine if remote sensing devices add any competitive advantage over tower measurements alone to predict turbine power response.

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